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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/541,089	03/31/2000	Hiroaki Takeuchi	0397-0404P	4024

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EXAMINER	
PADGETT, MARIANNE L	
ART UNIT	**PAPER NUMBER**
1762	

DATE MAILED: 10/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/541,089	TAKEUCHI ET AL.	
	Examiner	Art Unit	
	Marianne L. Padgett	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 May 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 & 4-10* is/are rejected.

7)☒ Claim(s) *5 and 7* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 5/5/04 has been entered.

2. Claims 4-5 and 7 objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Since all the limitations present in claim 5 have been placed in the independent claim by the amendment of 5/4/04, this claim is no longer further limiting. The limitation of claim 4 is already required in claim 1, unless the alternative P_L calculation is higher, in which case if the limitation of 4 was to replace the previously required higher value, this would lower the lower limit (i.e. make broader) of the previously claimed process range, which does NOT narrow it, hence is not properly further limiting.

Claim 7 is still dependent on claim 2, which has been canceled, hence is a dependent claim, which does not further limit any preceding claim.

3. Claims 1 and 4-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Markush group added to claim 1, in lines 12-14, is ambiguous, as it is unclear of what the grouping or listing of claimed gases consists. Specifically, it is unclear whether or not "an inert gas" is part of the Markush group, if it is a species in and of its self, if it only goes with "halogen base gases", or if it might also be employed with "gases containing silicon atoms". Also, since silicon-containing gases such as SiF_4 may also be halogen based, the species of the Markush group are not mutually exclusive,

hence are improper. Note with respect to the mixture, since both halogen and Si option are plural, they may supply the mixture. Also, note that "an inert gas" is introduced on both lines 13-14 and on line 18, lending support to the option that it is some how part of the Markush Group, and inert gas used in the claimed plasma process is some how arbitrarily divide between the partial pressure (P_r) and the balance of the pressure. As this is not consistent with applicant's arguments on p. 6 of their 5/5/04 response, it seems probable that the claim language as presently written is not consistent with applicant's intent. It is noted that fig. 8 appears to be counting the H_2 as well as the SiH_4, when giving the reactant's partial pressure; hence it's not just the gas with the claimed Si or halogen that's disclosed.

4. Claims 1, 4-5 and 8-10 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Whether or not it was applicant's intent, the claims have been amended to effectively remove any upper limit on the plasma processing pressure, since 500 Torr is no longer required to be the maximum pressure (except in claim 6, excluded from this rejection). As there is also no limit on the partial pressure (P_r) of the reactant gas, then $P_L=5P_r$ = unlimited, especially as it is the higher pressure of the options given, hence $P<3.5\ P_L$ is also unlimited.

The teachings of the specification appear quite clear and insistent on the importance and criticality of 500 Torr as an upper limit for pressure (pages 7, 10, 16, 24, 29, 33 fig, 1, etc). While the formula's now in the claims are present in the specification, discussion of them is always preceded by a statement including the 500 Torr upper limitation, such as the formula relationships that was deleted on line 9 of claim 1 in the 5/5/04 amendment. For these reasons, the amendments broadening the scope of the claims to effectively exclude an upper limit on pressure, appears to constitute New Matter.

5. Applicant's discussion on p. 6+ of their response, alleges that the amended claims provide a process for minimizing inert gas amount added to the reactive gas within a range such that the plasma can be kept stable, so as to effectively achieve plasma processing. This is NOT agreed with, because while the argument implies that the balance of the gas that is not the reactant (i.e. $P_{balance} = P - P_r$), is all inert gas, this is NOT necessitated by the claims, as the claims require no such limitation. The problem with the Markush group (see section 3 above) contributes to the problem, but also P_r is only for a reactant gas, thus there may be an unlimited number of different reactant gases that all contribute a partial pressure, thus $P=P_r + P_2 + P_3 + \ldots P_{balance}$. This would be consistent with the claim language for the claims as written, and a reasonable interpretation considering types of plasma reactions that may use multiple reactant gases, such as $SiH_4 + SiF_4 + O_2 + N_2O + B_2H_6$ + inert gas or the like.

Concerning language, note that "a reactants gas "is equivalent to --one reactant gas--, while introduction of the term without an article can indicate one or many, i.e. reactant gases as a group. Providing applicant's can show support in their original specification, would phrasing such as --setting a variable partial pressure of reactant gas or gases, P_r (Torr), where the remainder of pressure if from inert gas;-- provide applicant's intended meaning? The problems the Markush group/inert gas and new matter would also need to be corrected, and applicants should point out where in their specification the alleged effects of the claimed process are necessitated with plasma following claimed procedures.

6. With respect to Foster et al (6,140,215), the examples on. P. 14-16 use $TiCl_4 + H_2 + Ar$, where $TiCl_4$ reads on a halogen based gas, but calculations of partial pressure based on totaled flow rates and the chamber pressure of 5 torr give partial pressures of $TiCl_4$ ranging from about 0.012 T to 0.006T, for 0.05 slm Ar (500sccm) to 0.3 slm Ar (300 sccm), which gives P_L =.059 Torr to 0.030 Torr, thus ok for a lower limit, but fails for $P \leq 3.5 P_L$, as 5 torr is not $\leq$ 0.21 torr. If total reactant gas partial pressure is considered, i.e. for table 5 parameters, (10 sccm $TiCl_4$ + 3,750 sccm H_2 = 3760 sccm) / 4260 sccm) X (5 torr) = 3.9 torr = P_r (total), then $P_L = 5P_r \approx$ 19.7 torr which fails the criteria of $P_L \leq P$. The alternative P_L

calculation using 450 KHz gives 0.315 torr which is lower than 19.7, hence not chosen (and would fail on the upper limitation of the relationship for P). Therefore, it is agreed that Foster et al does not read on the claims as now written.

7. Yamazaki et al (5,932,302) teach plasma deposition from mixtures that may include H_2 and rare gas and some mixture of hydrocarbon, carbon halide and hydrocarbon halide, as well as halogen based gas such as the carbon halide causing etching (col. 9, lines 45-68+). Col. 15, lines 56-68+ give general ranges of useful pressures as 1-200 torr, with 50-100 torr being the most preferred, along with teachings an using rare gases (He or Ar) to improve discharge stability. Only the 12th and 13th examples on col. 19-20 employ a halide based gas in their reactive gases, hence while the there are a wider range of possible conditions that may be employed, only these provide explicit parameters that may be input in applicant's formula, with both using reaction pressure of 60 torr = P, and raw gas: $C_2H_4 : H_2 : Ar = 1: 1: 2$ (1000 sccm total) with additive gas C_2F_6 (addition of 10% to C_2H_4), where the latter may read on the claimed halogen based gases, to determine partial pressure $0.9x(C_2H_2) + 0.1x (C_2F_6) + X (H_2) + 2X (Ar)$ =1000 sccm, so X +250 sccm and $P_r (C_2F_6) \equiv 25$ sccm or P_r (total) $\equiv$ 500 sccm, thus $P_L (C_2F_6) = 5P_r = 7.5 < P$, but $3.5 P_L(C_2F_6) = 26.25$ which is not ≥ 60 torr. If the total reactant gas pressure is considered P_r (tot) = 30 torr, so $P_L=5P_r = 150$ Torr not< P. The alternative calculation of P_L using frequency = 13.56 MHz gives $P_L \approx 2.7$ torr, which is lower than either reactant based calculation, hence not chosen. While there remain examples in Yamazaki et al whose P_L for reactant gas fulfill the claimed formula's relationships, such as that on col. 17, which give $P_r = 9$ torr, P=100 torr, so $P_L=45$ T< 100T < $3.5P_L$ = 157.5T, but fail to use either halogen of Si containing reactant gases, so the 102 over Yamazaki et al is removed.

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 1, 4-5 & 7-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Bhan et al (6,001,728).

Bhan et al introduces helium along with process gases, including Si, O and a halogen element, into a parallel plate plasma reactor, although other plasma reactors are taught to be useful (abstract; Fig 1; col. 3, lines 58–col. 4, lines 35 and 56-68). High frequencies between 13-14 MHz, preferably 13.56, plus a low frequency less than 500 KHz, preferable 350 KHz are exemplified (col. 4, lines 20-28 and col. 5, lines 55-67). Note applicant's claim of a high frequency, does not exclude simultaneous use of a low one as employed in Bhan et al. Pressures employed are taught to be between about 1-100 Torr (col.5, lines

47-54), the He employed is taught to cause sputtering i.e. etching (col. 2, lines 60-67; col. 5, lines 2-22 and col.6, lines 37-67+) and gases such as SiF_6, TEOS, O_2, C_2F_6 are employed in dielectric film deposition (col. 7-8). Note that the Bhan et al process has deposition and etching occurring simultaneous, hence reads on claims of either, as well as surface treatment, which is inclusive of both.

Note for the specific example using SiF_4 or C_2F_2, that the use of 13.56 MHz, gives a P_L derived therefrom of 2.7 Torr and $3.5P_L$ =9.45 Torr. As the SiF_4 examples uses 4 torr (col. 7, line 46) and C_2F_6 examples 5 torr (col. 8, lines), it corresponds to use of values within applicants' claimed relationships. Calculation of P_r based on a reactant gas (col. 7: TEOS at 98.36 sccm $\rightarrow$ P_r =.14 T < 2.7; or SiF_6 at 550 sccm $\rightarrow$ P_r = .8 < 2.7 or TEOs+O_2 + SiF give a reactant total flow of 1248.36 sccm or P_r = 1.8 $\rightarrow$ P_L = 9.1 > 2.7) varies according to which reactant gas one chooses or all, however for any individual gas as claimed, P_L = 2.7 is greater for the SiF_4 (col. 7) examples, so P_L = 2.7< 4 torr < $3.5P_L$ = 9.45, satisfies the claimed relationship, hence reading on the claimed process. Note Bhan et al teach that use of He stabilizes the plasma as well as its stabilized effect on the deposit (col. 5, lines 16-20).

A similar analysis can be preformed on the C_2F_6 examples of col. 8. For the use of 4300 sccm He; TEOS at 99.44 sccm gives P_r =.088 T$\rightarrow$$P_L$ = 0.44; C_2F_6 at 400 sccm $\rightarrow$Pr =.35, <2.7, so P_L =5(.35) = 1.77 <2.7; or TEOS + C_2F_6 at 1339 sccm, P_r=1.19, so P_L = 5.9 > P, does not satisfy. For the individual reactant gases as claimed, the conditions are satisfied. Note when the additional experiment using increased He input is calculated for P_r of total reactant gas, P_r(tot) is about 1, so $P_L \approx 5 = P$ and this example satisfies for total reactant gases used to calculate the relationship.

These examples and the above analysis illustrate why, exactly what is required to be included for satisfying the claimed relationships, needs to be clearly delineated in the claims.

10. The Patent 5,827,785 also to Bhan et al, has related disclosure to those discussed above, but also uses an additional F-containing gas, which is also involved in etching reactions. However, while Bhan et al (785) also teaches use of pressure from 1-100 Torr, they do not state what process is uses with

a specific set of reactant flow rates, hence calculations to determine if the claimed relationship are satisfied, can not be preformed.

The patent to Mori (5,037666) is if interest for teaching plasma processes where pressure (total and partial) and frequency fit the claimed formula relationship for gases as claimed, however Mari introduces their high frequency (microwave) energy via a wave guide, not an electrode as claimed.

11. Claims 1, 4-5 and 7-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Spence et al (6,106,659).

Spence et al teach a plasma process for etching, surface treatment, deposition, etc., via plasma with medium to high pressure (10-about 760 Torr), using electrode assemblies that may be RF, where the frequency is either fixed or variable, where useful ranges are taught to include 1-100 MHz, or 30-82 MHz or 13.56 MHz or 27.12 MHz or 40.68 MHz or 81.36 MHz, etc. Various gases are taught as useful, including inert gases (Ar of He); F, Cl and/or Si-containing, where it is noted that below 150 T operating pressure, any gas may be used, but at 150 T and higher it is preferred to use an increased proportion of inert gas. See the abstract; col. 6, lines 9-16 and 53-col. 7, lines 13 and 26-col. 8, line 5; col. 9, line 25-col. 10, lines 11 and 43-58; and col. 15, lines 41-50+.

Some specific examples read on claimed parameters ranges, i.e. have all parameters satisfying conditions as required by claimed relationships that define the range claimed. See table 3, set II (PET) sample 4 where 2.0 lpm He + 0.17lpm C_2F_6 gives a P_r=4.39, so P_L = 21 (which is greater than P_L calculated for 13.56 MHz), thus P_L=21<56 torr <3.5P_L = 76.8 torr satisfies claimed criteria, and thus reads on claimed limitations.

In table 7 (discussed col. 24-25) the example using N_2 + N_2O+ He + $SiCl_4$ at flow rates (1.2 +1.O +1.7+0.4) liters/min for system pressure P=51 torr is said to be exemplary for RF direct plasma process from 50-760 torr, and provide faster more homogeneous depositions. Calculating the pressures for the

$SiCl_4$ reactant, P_r ($SiCl_4$) = 4.7 T, thus $P_L = 5P_r = 23.7$ which is greater than $P_L = 2.7$ from 13.56 MHz, and less than $P=51 \leq 3.5\ P_L = 83$ T, hence reading on claimed criteria.

12. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Spence et al.

While Spence et al teach the entire claimed pressure range of 100 to 500 Torr and significantly overlapping frequencies for the claimed 10-500 MHz, as well as the need to increase proportions of inert gas at $P \geq 150$ Torr; they do not provide any specific examples within these ranges that can provide parameter values to plug into the formula that determine the claimed parameter range. However, it would have been obvious to one of ordinary skill in the art to employ Spence et al's teaching with routine experimentation to determine useful reactant/inert gas proportions, with the expectation that significant number of useful parameters will overlap with claimed ranges, especially considering that what exactly is suppose to be included by "reactant gas" in calculating claimed parameter is unclear.

13. Other art of interest for teaching relatively high pressure plasma with use of inert gas for plasma stability include Iio et al (5,626,908, esp. see col. 7) and Wang et al (5,354,715, esp. see fig. 14 and col. 5).

14. Applicant's arguments with respect to claims 1 and 4-10 have been considered but are moot in view of the new ground(s) of rejection.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marianne L. Padgett whose telephone number is (571) 272-1425. The examiner can normally be reached on M-F from about 8:30 a.m. to 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained

from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

M. L. Padgett/af
September 17, 2004
October 4, 2004

MARIANNE PADGETT
PRIMARY EXAMINER